Rising on Rice:
The Story of Jeypore

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FOREWORD

When I joined the Central Rice Research Institute, Cuttack early in 1954, I was introduced to the rich genetic diversity in rice in Koraput. A few Japanese Scientists were documenting this heritage. CRRI also started collections and the work was expanded under the guidance of Dr S D Sharma. Dr Smita Tripathy did her Ph.D thesis work on the "Ecogenetic Differentiation in *Oryza sativa* L" in the Koraput region under Dr Sharma's guidance.

Orissa is a genetic paradise not only in rice, but also in mangroves and several millets. After the establishment of MSSRF in 1990, a priority programme taken up for study was the linking of biodiversity, food security and livelihood enhancement in tribal areas. Several of these areas are characterized by the enigma of co-existence of rich genetic wealth and prevalence of severe malnutrition and poverty. MSSRF therefore chose the Koraput area in 1995 for strengthening the *insitu* onfarm conservation traditions of the tribal families. Dr Smita Tripathy and Ms Pratima Gurung worked on this project under the guidance of Dr S D Sharma and did much to create awareness of the importance of genetic resources conservation and enhancement in that agro-biodiversity rich area. Both Smita and Pratima studied issues relating to the IPR of tribal families.

This work could be strengthened further with the help of Swiss Agency for Development Cooperation (SDC) from 1998 onwards. The present publication chronicles the work done during the last eight years in this region. I am glad the publication has brought out lucidly the work done so far and its theoretical and practical significance. We should not preach to the poor, particularly tribal families, about the need for conservation, when they are struggling for their daily bread. What is important is to create an economic stake in conservation. MSSRF adopted the following three-pronged strategy for this purpose.

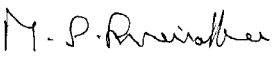
- Documenting the unique contributions of tribal families to genetic resources conservation and improvement, so as to get them recognition and reward from the National Gene and Biodiversity Funds set up under the Protection of Plant Varieties and Farmers' Rights Act and the Biodiversity Act.

- Improving the economic value of the produce through organic farming and promoting the production of health foods by tribal families.
- Improving the yield potential of important varieties of rice through participatory plant breeding and knowledge management.

This Publication brings out the impact of these initiatives not only on the ecological security of the area, but also on the livelihood security of tribal women and men. I am grateful to Drs V Arunachalam, Susanta Sekhar Chaudhury, Sukanta Kumar Sarangi, Trilochan Ray, Bibhu Prasad Mohanty, V Arivudai Nambi and Smita Mishra (nee Tripathy) for their dedicated work in documenting the work done and the results obtained. I am also grateful to SDC for its support for this important project, not only financially, but also technically through the active participation of Ms Lucy Maarse and Dr N R Jagannath in the meetings of the Steering Committee for this project.

I hope this Publication will stimulate more work in our tribal areas in the field of participatory plant breeding and knowledge management, and in identifying new avenues of improving the economic well being of the primary conservers of Orissa's rich genetic heritage.

MSSRF has also recently established the **Biju Patnaik Medicinal Plants Garden and Conservation Centre** at Koraput in land generously made available by the Government of Orissa. This Centre will help to elucidate the relationships between cultural and biological diversity and will enable the tribal families of Koraput to preserve for posterity their unique strains of rice, medicinal plants and other crops as well as their traditional wisdom.



M S Swaminathan

India is known as one of the mega centres of biodiversity. Jeypore tract in the Orissa state considered as a centre of origin of rice is home for a rich diversity of landraces. It is inhabited by ancient farming community with intense belief in tradition including crop cultivation. They are very poor, and many extremely poor, but they hold rich biodiversity in a range of crops including rice. Their staple food is rice. They prefer for consumption landraces, growing in their habitats for a long time past; they have also been conserving them from ancient days as a habit. Rice varieties that are used in various occasions like festivals, ancestral ceremonies, family functions and rituals are given top priority for conservation. Their traditional life style has been insulated from the present modern ways of life and comforts.

Traditionally, the tribal community practiced agriculture by the slash and burn method, also known as shifting cultivation (or in their local language podo cultivation). Usually, after the rainy season, the podo process would start from February by felling and burning trees in the hill land in forest slopes. The ashes would be left to fertilize the lands. When the summer monsoon sets in around May, they would prepare land by simply stirring the soil with hand hoes. Seeds of dryland crops like jowar, finger millets (mandya) and niger (alasi) would be broadcast. The heavy monsoon could wash away the crops down the hill slopes, in which case yields realized will be disastrously low. Most often, tribals use the land for shifting cultivation for 2 to 3 years, thus disturbing and delaying regeneration of forest cover. Over years, this practice of shifting cultivation is dwindling, and the rising population and extra forest security system highly discourage this method of cultivation.

The picture below illustrates shifting cultivation on hill slopes and paddy cultivation at foot hills. A winter oilseed crop of niger, whose oil is a common cooking medium of tribals, provides a nice landscape of yellow flowers with red soil in the background

Box 1:

Landraces are ecotypes cultivated for a long time in pristine habitats. Farmers have been exercising silent selection for traits preferred for their cooking habits and consumption culture. Selected forms become highly adapted to their native growing areas, conditions and the culture of tribals who practice a traditional agronomy as was explained to them by their ancestors. The traits that characterize such landraces express only in their sites of adaptation and if grown in other areas may not express fully. Therefore landraces are defined as site-specific. With this background, the terms, landraces and varieties, have been used interchangeably in this handbook

The bunded plain medium land in the foothill is used for growing short / medium duration paddy as mixed or mono crop.

It is common to see continuous cultivable lands fragmented. In such fragments of bunded uplands, vegetables are grown along with a cash crop, Eucalyptus. A few tribal households have such fragmented lands. Due to non-availability of appropriate agricultural lands, tribal women dig those fragmented lands with hoe, broadcast seeds in mono or mixed crop and leave it unattended till maturity. Low yields are regular in such hill land management.

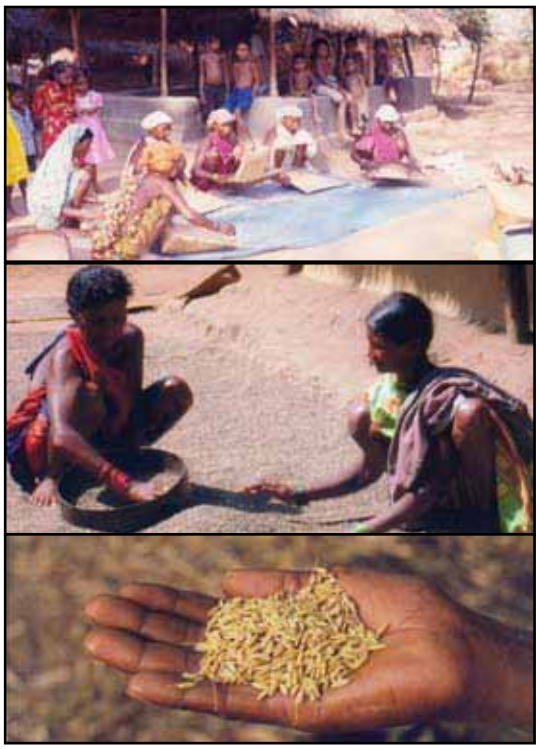
Tribal people are custodians of such landraces.

The rice land races in the tribal tracts show rich variability in panicle shape, size and pigmentation in spikelets.

Typically they reside in huts thatched with rice hay in areas not usually accessed by government for extending its welfare initiatives

Women play a major role in Agriculture and conservation of agro-diversity (see Box 2).

Most of the post-harvest operations are taxing and labour-intensive. Paddy threshed by trampling by cattle is cleaned using traditional winnows by women. They further clean them by removing weed seeds and extraneous matter using traditional filters. They daily pound paddy by hand using a wooden or iron pestle and mortar to get sufficient rice for the family.



At times, they also use a mechanical device in which larger quantities of rice can be pounded.

Broken rice and paddy hay are used as livestock feed.

It is also common for tribal women to grind millets (ragi, for example) using traditional grinding stone.

Women spend an hour at least to make a kg of ragi flour. Rice supplemented with

ragi in various preparations form the usual diet of tribal people. In this way, they get a balanced and nutritious food.

Traditional process of rice cultivation by tribals:

Farmers grow paddy in three types of land in the Jeypore tract. The first type is upland; those are flat lands on mountain slope (200m above MSL). The second is medium land; they are flat strips situated around 100-200m above MSL and the third is lowland situated below 100m from MSL. However, these academic definitions do not always fit the conception of farmers. In their location, farmers define upland, medium land and low land based on relative elevation and not really on exact height. Farmers use a practical thumb rule and define upland as one in higher slopes with no possibilities of irrigation except rainwater. During torrential rains the standing crop in the upland runs the risk of getting washed away. On the other hand, low lands are plain land usually with some irrigation facilities. Medium lands are those in between upland and lowland.

Box 2:

Role of Women in Agriculture and Conservation

A woman in a tribal family has many roles to play. Particularly she looks after home and the field with perfect balance. Collecting firewood, fetching drinking water, cooking food for the family, keeping the house neat and clean, and taking care of her young children and family are regular daily chores.

In addition, she plays a significant role in agriculture. She clears forest patch on the hills for shifting cultivation, prepares the land by breaking clods with a handmade hammer and other activities, except ploughing or threshing using bullocks. Right from field preparation till harvesting and storing food grain, processing and cooking, women play a crucial role. Seed selection and conservation of plant genetic resources stand out among the farm activities of women.

Harvesting and threshing

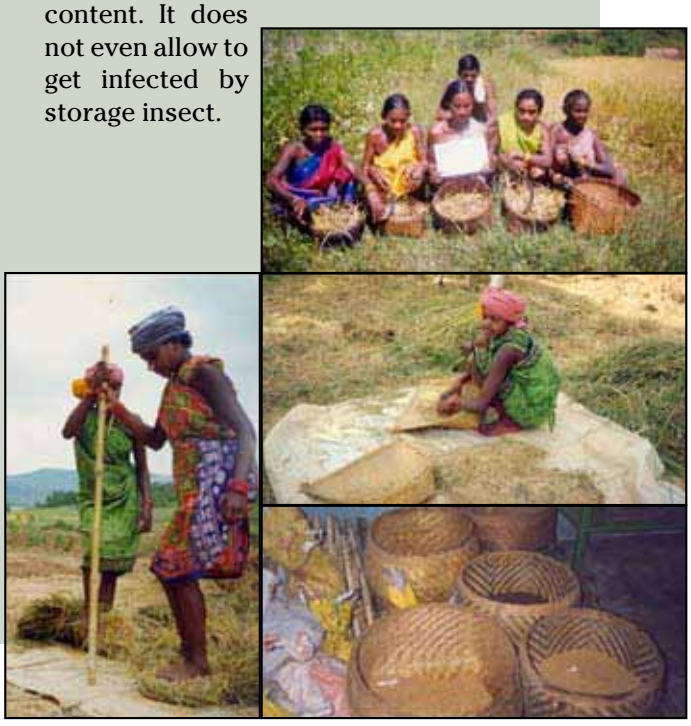
Women in the village households help each other by lending their hands to harvest paddy in their fields and transport them to threshing yards and also taking part in threshing. Such sharing of labour for harvesting crops is the usual practice in tribal and rural communities. This practice does not allow monetary transaction between two parties. This healthy tradition helps communities to maintain harmonious relationship, a vital component for any cooperative endeavour.

Selection of Seed

After cleaning the threshed paddy, woman separate paddy for using as seed, and for consumption. Healthy panicles are selected and threshed carefully and seeds saved for next season. Often times, selection of healthy panicles is also done in standing crops before harvest. In selection of seeds, women use their knowledge on crop characteristics like husk color, grain colour, grain size and such other characters. Women take care to dry and stores seeds properly.

Meeting overall food needs of the family: Tribal women feel very responsible for ensuring food security in her family. They store various food material for consumption when rice and other cereals become scarce in off season. Some of them are mango pulp, jack fruit seeds, radish (leaves, stem), cauliflower leaves, bamboo shoots, Ziziphus fruit, mushroom, tamarind, chilly, fish and meat.

Storage systems: The tribal people have their own indigenous way of storing various crop seeds and grains. Paddy seeds are stored in locally made structures called “Dhoosi” and “Khanike”. The Dhoosi is made up of long straw rope twined spirally. After keeping seeds, the top is tied tightly. Khakini is a big pot shaped bamboo basket plastered with cowdung paste. The cowdung pest acts as an insect repellent. After storing seeds the mouth is covered with a bamboo plate plastered with cowdung paste. It is said to be air tight and has minimum moisture content. It does not even allow to get infected by storage insect.



If the demarcation between upland, medium land and lowland by the tribal farmer is hazy, allotment of landraces to those lands is made purely on tradition. This process only goes to confirm the steadfast tribal faith in tradition, traditional definition of landscapes and the landraces to be grown.

Aus ecotype

Jeypore Tract is considered to be a centre of origin of Aus ecotype of rice. The tract comprises of the southern parts of Orissa and its adjoining areas inhabited by many tribal groups belonging to Proto-Australoid ethnic stock who speak austric languages. They were "harvesting" for ages, *Oryza nivara*, (annual wild species) that grows naturally and frequently in seasonal ditches. They were practising shifting cultivation and growing many landraces of rice. When shifting cultivation was dissuaded by various factors, they started cultivating lowland rice but with old and traditional landraces.

Ramiah (1953) was the first to propose that Jeypore tract represented an independent center of origin of cultivated rice that was seconded subsequently by many others. More than 1,750 traditional cultivars of rice existed during 1955-60. Oka and Chang (1962) based on their independent investigations, regarded Jeypore rices as forms intermediate between cultivated and wild types "still staying in the midst of differentiation". Later Sharma *et al*. (2000) concluded that this area could be a center of origin of the aus (early maturing upland varieties) ecotypes.

The aus rices of the Jeypore tract have many special features such as short height, thin culm, few tillers, small panicles with awns, and often (though not always) black /brown husk, red/ light red kernel. They are of short-duration. In fact, similar types of rice cultivars are often cultivated as a rainfed upland crop especially in unbunded / bunded fields in Chhattisgarh, Western Orissa and Southern Bihar (Jharkhand). These land races (locally known as tikradhan, bhatadhan, goradhan, etc.) have been collectively referred to as "Southeast Indian hill rices" or by the

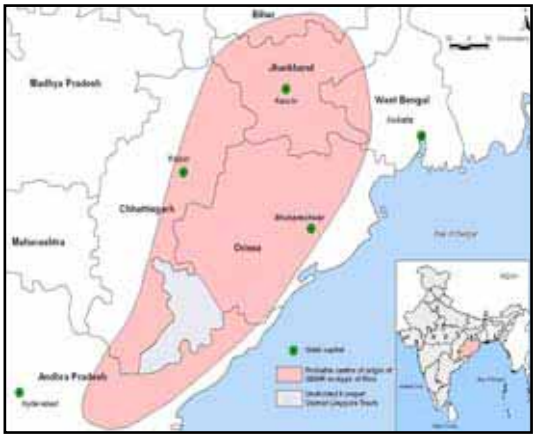
Ramiah, K. (1953). Rice Breeding and Genetics Scientific Monograph No. 19, Indian Council of Agricultural Research, New Delhi.

Ramiah, K. and R.M.L.Ghose (1951). Origin and distribution of cultivated plants of South Asia Rice. Indian J. Genetics. 11: 7-13.

Oka, H. I. and W. T. Chang (1962). Rice varieties intermediate between wild and cultivated forms and the origin of the japonica type. Bot. Bull. Acad.Sinica 3(1): 109-131.

Sharma, S. D., Smita Tripathy and J. Biswal.(2000): Origin of O. Sativa and its ecotypes. In: Rice Breeding and Genetics – Research priorities and Challenges (Ed. J.S. Nanda), Oxford and IBH publishing Co. Pvt. Ltd., New Delhi, pp. 349-369.

acronym "seihr". These "seihr" types have retained many primitive features, express dominance in their crosses, for many of the characters. The "seihr" types may, thus, be assumed to have originated directly from O. nivara of Southeast India.



Origin of Primary Ecotypes

There are three growing seasons of rice in Orissa. They are aus or autumn, aman or winter and boro or summer, locally known as beali, sarad and dalua rice respectively. Autumn rice is sown in May-June and harvested in September-October. Winter rice is grown in June-July and harvested in November -December. Summer rice is sown in December-January and harvested in April-May. Autumn and winter rice are together known as Kharif rice.

The rice cultivars that are grown in bunded fields during the Autumn (June-September) season and mature in 90 to 120 days are collectively known as aus types. In fact, cultivars similar to aus types are widely cultivated in the whole of Southeastern, Northeastern and Eastern India although they are called by different names in different states. Ecocentrically, they are one and the same group that has been termed as aus in rice literature. The aus cultivars are genetically superior to "seihr" types in their yield attributes and respond better to agronomic practices. The aus ecotype seems to have evolved directly from the upland rice (" seihr") of Southeast India. Traditionally, aus types were grown only under rainfed conditions.

Cultivation of traditional varieties

Tribal farmers grow a number of traditional varieties timed to mature in months matching festive or ritual occasions. Another reason is to harvest landraces in months like September, when the earlier harvested food gets exhausted. Farm families make good the shortage of food from the fresh harvest. Farmers do also practice mixed cropping with upland rice (Aus ecotypes) to insure against crop failure.

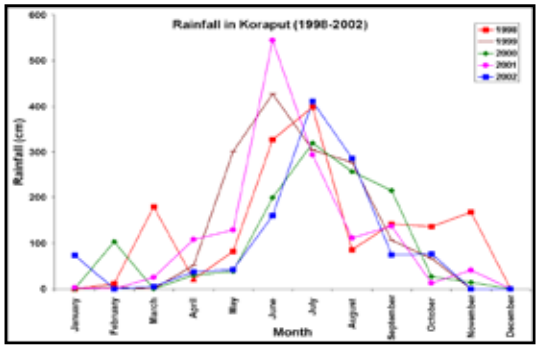
Cultivation practices are also decided by ancient tradition handed on by ancestors to the present day farmers. The land zones are completely rainfed and it is usual to experience unpredictable weather (in terms of amount and distribution of rainfall, temperature and its duration). Most often excess rain at flowering period and less or no rain at grain fill stage cause poor yield as would

Some valuable rice landraces preserved by Orissa tribal farmers for religious function

Rice variety	Predominant quality	Festivals	Time of maturity (Month)
Kalakrishna	Scented	All festivals	January
Tulsi	Scented	Chaitra Parva	April
Machhakanta	White slender short grins, good taste	Manabasa and Lakshmi Puja	November
Mer	Black grains with medicinal properties	Annual ceremony of forefathers	November
Kalajeera	Scented	Temple deities	November
Haladichudi	White slender long grains, good taste	Shakti puja	December
Deulabhoga	Bold and short grains, reddish tinge on cooking with mild scent preferred during worship at temples	Temple deities	December

be exemplified by the rainfall pattern over the period 1998-2002.

This is a reason why tribal farmers have been advocating a high seed rate (80 kg and above per acre) and a dense plant stand. This practice, instead of resulting in sustainably high yield, gave poor yields as the highly dense plant population suffers competition for low available nutrients. Due to unpredictable yield recovery, farmers do not like to spend money and labour for good management of fields. The inadequate land preparation usually results in clods of soil holding large number of plants with their roots not even reaching soil, for example. Such inadequacies result naturally in poor yields.



As a measure of improving the lot of tribal poor, and to provide an alternative for the low yields of landraces, the State Government extended knowledge of cultivation of High Yielding Varieties (HYVs). The Government not only supplied seeds and inputs at subsidized rates but also guaranteed buy-back of the harvested paddy. Farmers switched over to this option for utilizing the economic benefit but continued to grow small areas with their preferred landraces for consumption. Marginal farmers (who own less than half an acre) could not find it possible to grow both HYVs and landraces. In due course of time, they started preferring HYVs and slowly withdrew from growing landraces. Thus well-intended government measure to help poor tribal farmers unwittingly enabled slow and steady erosion of rice biodiversity. From around 1750 landraces in the 1950s, the Jeypore tract was left with only around 350 in 1998.

MSSRF was concerned with the fast depletion of rice diversity from its center of origin. The pro-poor, pro-nature, pro-women mandate of MSSRF demanded improving the lot of the poor farmers concurrently reviving vanishing rice landraces. At that time, the Swiss Agency for Development and Cooperation (SDC) came forward to fund a project on conservation, utilization and enhancement of Biodiversity.

In 1998, MSSRF scientists made a pilot survey of farmers' fields at Jeypore to understand their traditional practices of rice cultivation. The major maladies identified were as under:

- Poorly prepared land
- Direct seeding with high seed rates (60-80 kg/ha) of poor quality seeds
- Low benefit from traditional method of land race cultivation
- Lack of knowledge on scientific cultivation
- Compulsion for increased income to meet increasing cost of living
- The maladies of cultivation were discussed with Jeypore farmers in a series of PRAs (Participatory Rural Appraisal). The causes for switch-over to HYV cultivation, even at the cost of their preferred rice landraces, were understood.

In such PRAs, both men and women farmers jointly prioritized the following as major problems in rice cultivation:

1. Non-availability of quality seeds and ignorance of scientific cultivation practices This would explain the disappearing culture and cultivation tradition, and in general, attention to agriculture.
2. Unpredictable weather

   This is a reason for poor yields despite proper initial management of rice crop.
3. Non-availability of necessary funds, natural calamities, lack of crop insurance and low Government help

   This has resulted in a declining interest of farmers in rice cultivation and conservation.
4. Lack of irrigation facilities

   This is a major policy issue to be addressed by Government as a long term initiative.
5. Disease and pest incidence

   This is essentially a consequence of HYV cultivation; Application of chemical fertilizers and chemical control of pests occurring in HYVs has started affecting cultivated landraces and farmers have started realizing this situation.
6. Lack of labour for crucial field operations. This is a consequence of inadequate income and food grains from traditional agriculture, and farm men and women work as non-farm labour for meeting their family needs

The causes of maladies they listed were explained to the farmers. They were made to understand the inadequacies of traditional methods of cultivation, in particular, the poor yields even when the crops did not suffer weather constraints. They were informed that modern agronomic practices advocate optimal plant population as a crucial step in realizing good yields. In that context, possibilities of modifying traditional cultivation while retaining the indigenous technical knowledge given by their ancestors were pointed out. While farmers agreed and were willing to learn and test the modified practices, they were only marginally convinced that the modifications could result in yield improvement. We shall refer to the modified agronomy interspersed with traditional practices as "Modified" cultivation in contrast to the traditional practices of the farmer that would be referred to as "Farmer" cultivation.

It was then decided to test the Modified cultivation module in participation with farmers. Participatory breeding including participatory seed purification, participatory breeding and participatory conservation was chosen as the path to demonstrate the benefits of Modified method.

The following important observations were given serious consideration:

1. The initiative to replace the Farmer method of cultivation must succeed in the first attempt; otherwise farmers

with steadfast belief in their ancestral method would withdraw from further participation.

2. The method suggested should be simple and doable by farmers themselves.
3. It should not increase the existing cost of cultivation.

Since farmers with high ancestral tradition would resist change, it was felt prudent to use the principle of 'Practice better than precept'. Farmers were made to understand each step of the Modified module. Scientists worked with farmers in their fields to demonstrate the various steps of Modified cultivation.

During 1998, farmers planted 26 landraces of their choice in small plots of 5 cents each (200 sq. m) in upland, medium land and lowland using traditional methods of cultivation. However, due to heavy rain the crops suffered and gave poor yields. The results were discussed with farmers who suggested replacing 13 varieties with a new set of 9 varieties for evaluation in 1999 thus giving 22 varieties.

In 1999, the start of the PPB experiments, farmers were taught of a field layout for growing landraces using Modified and farmer methods side by side. From the 14 villages and 14 farmers (one each from each village) who participated in 1998, 9 villages and farmers have volunteered to layout participatory experimental plots with 22 landraces.

Selection of varieties for participatory evaluation

Varieties Tested	1998	1999	Common Bet '98 and '99
Upland	10	6	3
Medium Land	6	8	1
Lowland	10	8	3
Performance of varieties in 1998 discussed in PRA with farmers Based on 1998 performance and farmers' ITK, varieties for 1999 selected with farmers' participation			

'Farmer' plots of 90 sq.m used farmers' method of cultivation. 'Modified' plots were of size 30 sq.m. and were laid in three replications adjacent to farmers' plots. Thus the plot size for a landrace in a "farmers plot" (90 sq. m) would be equal to the area occupied by the landrace over the three replicates under the "Modified plot" (3 x 30 sq. m)

Participatory Varietal Evaluation (1999)

Each variety under Modified and Farmer practices side by side Modified plots replicated, Farmer plots unreplicated	
R I V3 V5 V6 V1 V4 V2 R II V5 V2 V4 V1 V6 V3 R III V3 V6 V1 V5 V4 V2	V1 V2 V3 V4 V5 V6
Plot: 30 sq.m. 50 rows of 3 m length M O D I F I E D	Plot: 90 sq.m 150 rows of 3m length F A R M E R

PPB Sites (villages) in the exploratory (1998) and activity (1999) phases

District	Block		Upland		MediumLand		Low Land	
Koraput	Jeypore	E	Balia	6	Okilaguda	8	Pujariput	21
		A	Barangput	12	Patraput	17	Patraput	17
							Pujariput	21
	Boipariguda	E	Kolar	39	Bhaluguda	43	Bhaluguda	43
		A	Tolla	22	Tolla	22		
			Mohuli	20	Mohuli	20	Mohuli	20
Malkangiri	Khairpur	E	■ Khemaguru	60				
	Mathili	E			■ Uduliguda	63	Sindhabed	67
	Malkangiri	E	■ Batapalli	115	■ Teakguda	115	Batapalli	115
Nabarangpur	Nabarangpur	E	Badakumuli	62	Badamukuli	62	Hatibeda	60
	Nandahandi	E	Mentry	65	Mentry	65	Mentry	65

■Dropped out mid-way; E - Exploratory (1998) - 14 farmers; A-Activity (1999) - 9 farmers (3 each in upland, medium land and lowa land); Figures following sites represent distance in km from MSSRF Office at Jeypore; One farmer from each village; note some farmers gave all the types of land In the same village

Traditional practices of cultivation were followed in farmers' plots, while the following Modified methods were practiced in Modified plots

Modified and Farmer method of cultivation

Farmer	Modified
Land Preparation	
Light and a few ploughings in lowland Digging in upland	4-6 deep ploughing
No special provision for water channel draining excess water	Provision for water channel along the for slope of the land
A few cartloads *N5) of FYM per acre	10-15 cartloads of FYM per acre
Application of FYM during sowing	Application of FYM at least a month in advance and incorporating it into the soil by light ploughing
No seed selection before sowing	Selection of seeds by soaking the seed lot in water and sowing only those, which sink

Farmer	Modified
Nursery	
In uneven patches of land and broad-casting seeds in a haphazard manner	Fairly leveled lands under appropriate moisture levels; line sowing in raised seed beds of 15 m length, 1.5 m width and 30 cm height, with channels of 30 cm width
Some water for uprooting seedlings	15-20 cm water
No specified area	10% of the area to be transplanted
Direct sowing in Upland/Medium Land	
Broadcasting seeds with a seed rate approx. 60-80 kg/acre	Sowing in rows spaced 20 cm with plant to plant distance of 10 cm (seed rate 12 kg/acre)
Transplanting	
No fixed age of seedlings, usually upto 45 days	21 to 25 day old seedlings
Haphazard transplanting	Line sowing with 20 cm between rows and 10 cm between plants within a row on leveled plots.
No specific direction of planting	North-south planting to capture more sunlight
Weeding	
No specific number of weeding	Two and if necessary three weeding between lines

Water Management

Stage	Farmer Method	Modified Method
Ploughing of land	High Standing water (SW)	Water as needed
Puddling	> 5 cm SW	2 to 5 cm SW
Transplanting	> 5cm SW	A thin film of water
Transplanting to seedling establishment	> 10 cm SW	2 to 5 cm SW
Seedling establishment to tillering	> 10 cm SW	Alternate wetting and drying Wetting ~ 2 to 5 cm SW
Tillering to dough stage	> 10 cm SW	5 cm SW

Farmers were encouraged to adopt traditional methods of control of biotic stresses (that are of low occurrence in tribal areas) like neem oil preparations

The results from the participatory experiments were remarkable. The average yield under Modified method was statistically superior to farmer method in all the land types for all varieties. The extent of yield improvement varied from 30-70%, which was substantially high when considered with the fact that the results were obtained with no extra inputs and without any increase in the cost of cultivation. There was a substantial increase in yields through Modified cultivation in the fields of every farmer. However, variation in the extent of improvement was observed across farmers. This could be attributed to farmers' varying landholdings and variation in the adoption of Modified practices. Scientists trained farmers in Modified methods of cultivation in their fields up to the stage of transplanting; afterwards farmers followed weeding, irrigation and harvesting procedures based on instructions given in the training sessions.

Regardless, the benefit :cost ratio of rice cultivation was significantly improved in 1999 on Modified practices compared to farmers' practices both in 1998 and in 1999.

In the first year there was a general apprehension that the cost of labour for transplantation was high that could add up to the cost of cultivation. However, when taken with reduced costs for weeding, harvesting and transporting rice grown in rows, it became clear that, other than the distribution of costs over various field operations, the total cost remained the same.

Benefit of Modified Method over Farmer Method of Rice Cultivation

Land Type	Variety	Av. Yield (kg/ha	1999	
		1998	FA	FO
Lowland	Bayagunda	1755	3679	2321
	Gadakuta	1352	1524	961
	Barapanka	1643	3438	2533
	Kalachudi	1309	2562	2007
Medium Land	Bodikaburi	1261	2838	1736
Upland	Paradhan	561	1028	622

FO - Modified ; FA - Farmer ; 1998 : Yield estimate based on plots of 80 sq. m

When the yield advantage under Modified planting was examined in the light of this potential market value, it was found that the benefit was much higher ranging from 37 to 135% over cost Individual farmers realized much higher advantage of the order of 298% in lowland, 209% in medium land and 162% in upland.

The cost of labour was partitioned into five major components, ploughing, FYM application, sowing, weeding, harvest and post harvest. It was found that the cost of labour (over the nine farmers) between Modified and farmer method of cultivation was not statistically significant for any of the five components in any of the land type. This observation gained strength in subsequent years when the tribal farming community could do line transplanting more efficiently in less amount of time (meaning no increase in labour cost.)

Scientists and farmers characterized the landraces through a number of quantitative traits observed on random samples of plants. Plant height, number of tillers, number of panicles, average length of panicle, number of filled grains per panicle, grain fill index (= proportion of number of filled grains to total number of grains in panicle) and Harvest Index were the key component characters on which performance of a landrace was estimated. In this process farmers learnt various morphological characters related to yield performance and also observed off types that were removed before harvest. Special training

Benefit: Cost ratio (Rs.) under modified rice cultivation

Land type	No.of farmers	Exptl. Area (sq.m.)	Method	Benefit	Cost (Rs / ha)	B:C	r
Upland	3	1799	FCM	5007	5687	0.88	0.60 - 1.62
		1800	FTP	4389	2709	1.62	
Medium land	3	1709	FCM	13815	8618	1.60	0.94 - 2.09
		936	FTP	10071	7357	1.37	
Lowland	3	2300	FCM	14144	6023	2.35	1.31 - 2.98
		1240	FTP	1109	5944	1.87	

FCM: Modified Cultivation Module; FTV: Farmers' Traditional Practices;
r: Range of B:C across farmers

was given to them to select panicles with well-filled grains as seed material.

Thus farmers could do seed selection and also varietal purification after three seasons of knowledge addition and practical training by MSSRF scientists.

Data on the quantitative traits were analyzed statistically and the top two varieties based on their performance over the quantitative traits were selected.

Based on significance tests over 7 traits, a performance score was allotted to each variety and the varieties were ranked. Ranking on performance scores (PR) and ranking on yield alone (YR) varied in upland, medium land and lowland cases. In the case of upland, though there were six varieties, only 5 groups were distinguished based on overall performance.

Ranking based on performance on seven quantitative traits (PR) and on yield alone (YR)

Variety	Yield (q/ha)	PR	YR
Upland			
Paradhan	1173	1	1
Matidhan	939	2	5
Pandakagura	1027	3	4
Osagathiali	1133	4	2
Pathara	898	5	6
Mora	1046	6	3
Medium Land			
Sapuri	3515	1	1
Limbachudi	2915	2	3
Haladichudi	2964	3	2
Veliyan	2901	4	4
Bodikaburi	2455	5	6
Mer	2847	6	5
Gathia	2334	7	7
Parijat	1913	8	8
Low Land			
Barapanka	3438	1	2
Kalajeerai	2459	2	6
Lalata	3130	3	3
Bayagunda	3679	4	1
Veliyan	2856	5	4
Kalachudi	2562	6	5
Machchakant	1671	7	7
Gadakuta	1523	8	8

This process was discussed at length in a PRA. The scientific selection of landraces based on performance given by 7 traits was matched with the farmers' selection based on their Indigenous Technical

Knowledge (ITK). It was heartening to observe that the match was perfect excepting one case where the ranks 1 and 2 on performance were scored as 2 and 1 by farmers. It was also found that ranking on yield alone was highly different from that on performance through statistical evaluation.

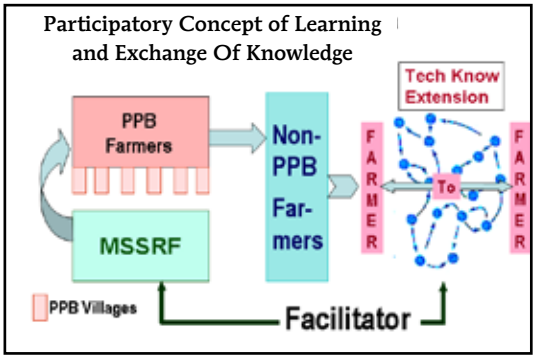
Varieties finally selected for large scale demonstration

Land Type	Varieties	YD	PR	YR
Upland	Paradhan	1173	1	1
Medium Land	Sapuri	3515	1	1
	Limbachudi	2915	2	3
Lowland	Barapanka	3438	1	3
	Kalajeera	2459	2	6

YD: Yield (kg/ha); PR: Ranking based on performance on 7 traits; YR: Ranking on yield alone

This would emphasize the role of science of plant breeding in detecting potential farmers' landraces.

These selected varieties were put in large demonstration during kharif 2000. In this endevaour, farmers from other villages who learnt about the new methods of cultivation from their fellow farmers (farmer to farmer extension of knowledge) also joined.



Thus the number of farmers who laid the demonstration plots rose from 9 to 38 in one year.

The Distribution of PPB farmers in Jeypore Tract, Koraput district Kharif 2000

BL	NV	UP	MD	LL	Total
Jeypore	3	1	3	5	9
Boipariguda	4	3	6	8	17
Kundura	3	2	5	3	10
Laxmipur	1	-	1	1	2
Total	11	6	15	17	38

BL: Block; NV: no. of villages; UP: Upland; MD: Medium land; LL: Lowland

Distances of villages from MSSRF, Jeypore:

kms	no. of villages
10 - 20	4
21 - 35	4
*36 - 75	3

*managed by other NGOs

Some farmers who grasped the concepts of Modified breeding well could lay good demonstration plots and reap high yields. For instance, the yield of more than 5 tonnes per hectare based on a large plot in medium land and on a relatively smaller plot in lowland are remarkable achievements from growing landraces under almost organic conditions with no special inputs.

However, farmers could not adopt all the components of the Modified module, mentioned earlier. But it was clear that space planting was practiced by all

Yield advantage realised by some farmers by modified cultivation of LR in large areas (Jeypore, Kharif 2000)

LR	Farmer	Land type (sq.m)	Area sown	Yield (kg/ha)
Sapuri	Sunadhar Katia	ML	1633	5883
Limbachudi	Trilochan Ghiuria	ML	1321	4466
Kalajeera	Dhanurjoy Pujari	LL	570	5700*
	Trilochan Ghiuria	LL	1178	4149
Barapanka	Jagannath Patnaik	LL	2400	5766**

Sold grains in the local market * at Rs.10/- kg, ** at Rs.12/-kg; LR – Land Race, ML – Medium Land; LL - Lowland

following Modified methods (Rank 1) followed by stipulated seed rate (Rank 2), and proper nursery preparation (Rank 3), FYM application and proper land preparation getting lower ranks. This would imply that, when the full module is adopted by the farmers, expectedly, the yields of landraces would go up.

Adoption of Modified Module by Farmers

Adoption Rank	Component
1	Space Planting
2	Optimal Seed Use
3	Nursery reparation
4	Full Modified Module
5	FYM Application
6	FYM Preparation
7	Land Preparation

In sum the scientific cultivation has highlighted the following benefits to the tribal farming community at Jeypore:

- The scientific method gave 60-70% yield increase of their preferred landrace thereby offsetting the shortage of food for consumption during a year.
- Modified practices converged with farmers' knowledge of cultivation and retained many provisions of traditional method like land leveling, FYM application, harvest methods etc.
- Non-increase in the cost of cultivation was one of the significant benefits of Modified method, which in addition helped to contain weeds and facilitated easy harvest.
- Modified methods were easily doable with a significant saving in seed rate and therefore cost.
- Participatory learning by farmers and its practical adoption by themselves gave them adequate knowledge and confidence to extend it to fellow farmers
- This participatory initiative has instilled confidence in farmers to seek a secure livelihood based on their native landraces (natural resources).

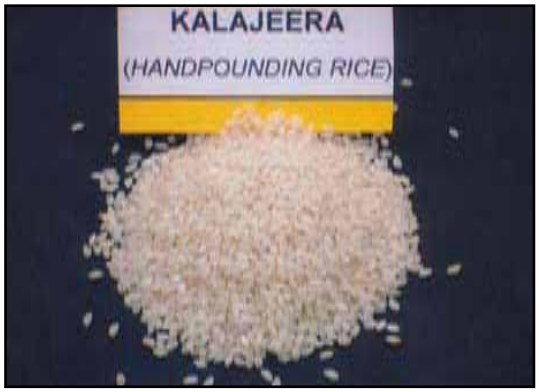
At this stage of improvement in Jeypore, a government fair (PARAB) was conducted in 2003 in which

hulled rice of landraces harvested under Modified practices were displayed. One of the lowland varieties selected through participatory varietal purification was Kalajeera. It had black husk liked by the people of Orissa, high aroma and many other characteristics like taste, good cooking quality, capacity to add taste to many items of food like briyani in addition to its amenable properties for value addition like puffed rice, beaten rice and other snacks. Kalajeera rice could sell at a high price of Rs. 25/- a kg compared to the usual Rs. 8-10 a kg. Farmers observed the marketing potential of Kalajeera and expressed a unanimous desire to produce large quantities in the next year.

Descriptors of Kalajeera
Indicative Values of Agronomic / Morphological Characters*

Planting season	Mid June - Early July
Mode of planting	Raising Nursery and transplanting 3 week old seedlings
Days to flower	120 days
Days to mature	153 days
Synchrony of tillering	Very good
Plant Height	120 cm
No of tillers per plant	7
No of panicles per plant	7
Panicle length	5 m
No of filled grain per panicle	175
1000 grain weight	15 g
Grain yield per hectare	3 t
Straw yield per hectare	5.5 t
Colour of the grain	Black
Shape of the grain	Small, Oval
Length of the grain	7 mm
Breadth of the grain	3 mm
Special Character	Aromatic
Market Potential	Grain Rs.750 to Rs.800 per quintal Rice Rs.2200 to Rs.3000 per quintal Seed Rs.800 to Rs.1000 per quintal

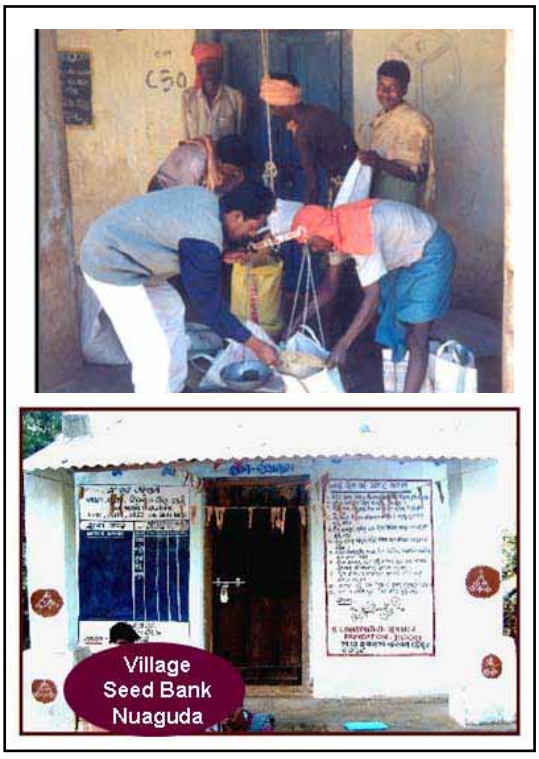
* The metric values of the agronomic/orphological characters of Kalajeera are subject to normal variations across sites, seasons, years and different systems of crop management



During kharif 2004, 7 farmers allocated their small land areas to form a continuous strip of 6.22 acres exclusively for production of Kalajeera seed. The scientists worked with the farmers to grow an optimal crop and select quality seeds. There was a yield set back due to heavy rains at the flowering phase. Despite this, the area yielded 29 q of seed and 14 q of grain. The cost of production was Rs. 13, 840/- while the amount earned by sale of grains was Rs. 21860/- giving a profit of about 60%.

The problem then arose of storing the seeds and grains until disposal safely. This was addressed in PRAs with various village farmers even in the previous year. Two pathways were found feasible: 1)

asking for Government support and 2) providing the facility with the strength of village communities. The former will take considerable time to work through various channels while the latter could fructify at village level. Farmers decided to construct small seed banks in each village. MSSRF helped them to provide for partitions to store gene (equivalently, nucleus seed), seed (equivalently, breeder seed) and grain. By the time, seeds of Kalajeera were produced in 2004, five village seed banks were already constructed by villagers themselves.



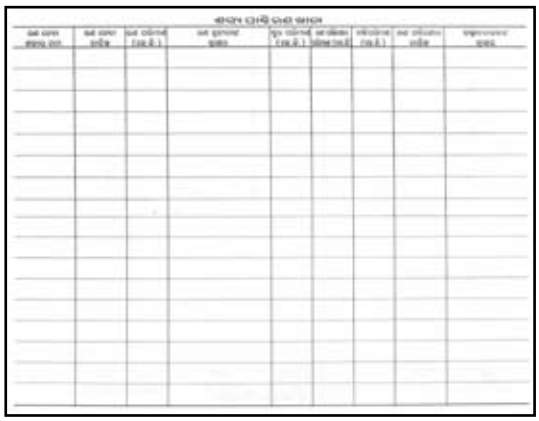
Each seed bank had provisions for storing relatively large quantities of grain and space for storing seeds of selected landraces. Pure nucleus seed of landraces grown in the block where the village is situated were scientifically packed in aluminum foil seed envelops and kept in the concerned seed bank itself. The community decided to call such Gene-Seed-Grain Banks by the short name Village Seed Bank (VSB).

It took sometime for bringing VSBs to a functional mode. Cooperative storing of grains, marketing them in one lot and sharing the income among farmers according to their individual contribution remained to be put into active practice. Pending search for regular marketing channels, grains that were deposited at the end of Kharif 2004 in VSBs were sold in local markets or distributed among local people. It was found feasible to sell hand-pound rice instead of paddy. The women farm community came forward to undertake this arduous task and eventually hand pound rice was sold to local farmers at a fair price.

It was then people came to understand the problems of marketing paddy and rice when produced in large quantities. The next problem was the distribution of seed deposited collectively in VSBs to cultivating farmers in the next season. It needed a participatory solution.

MSSRF suggested that there should be a seed management committee with members selected from village farming community. Like any normal bank dealing with money, the village seed bank was set to deal with cash (from the sale of rice) and kind (paddy seeds or

grains). A passbook was provided to each contributing farmer in which details of deposit (cash/kind), withdrawal and loan were recorded. Particular attention was given for including women members in the management committee to give them their due in decision making.

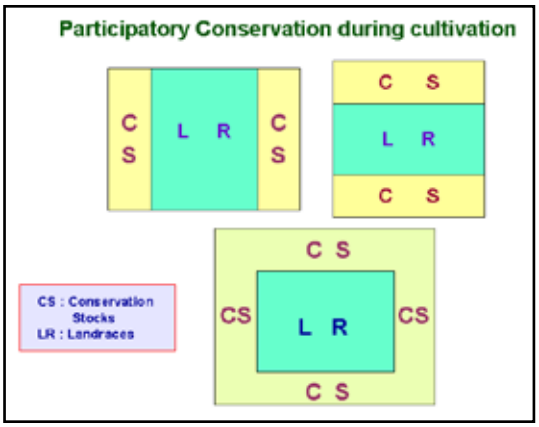


During kharif 2005, all the seeds of Kalajeera stored in VSBs were distributed for large scale production. Due to the positive impact created by Kalajeera, farmers from neighbouring areas came forward to grow it if seeds could be provided from VSBs. 11 villages belonging to 6 panchayats participated in large scale production of Kalajeera in 66 acres of land during Kharif 2005. Despite erratic distribution of rainfall during the crop season, the crop did well with yield ranging from 20 to 40 quintals per hectare. Poor management by small farmers without any possibility for draining excess water was a reason for low yields. Farmers were also encouraged to select for seeds in each field. At the end of the season there was thus collection of 75 quintals of seed and of 293 quintals of grain. Marketing the 293q of grain became again a crucial problem. The nearby local markets or the rice mills did not offer a remunerative price for various reasons. The landrace Kalajeera was produced in large quantities for the first time. The traders wanted to purchase the farmer produced Kalajeera at a low price. MSSRF brought this problem to the attention of the State Government of Orissa and requested its help to procure this traditional and aromatic variety. National Agricultural Cooperative Marketing Federation of India Ltd (NAFED), a subsidiary of Government came forward to procure grains on the recommendation of the Government,

Farmers were involved in the process of packing well-dried quality grains in gunny bags and stacking it in a rural godown hired for the purpose. NAFED checked the quality of the material and being satisfied with the high quality, they procured the whole grain lot at the rate of Rs.10 per kg. This price was highly remunerative and matched with the one usually offered for Basmati variety by export market. Farmers were overjoyed in realizing maximum benefits from their traditional landrace for the first time.

Participatory Conservation

A hypothesis set to be tested while working with the tribal farming community on PPB was whether the experience would trigger voluntary conservation of landraces by the farming community. After farmers realized high economic benefits with purified landraces of their choice, knowledge on the crucial need to conserve landraces was extended. A module of conservation concurrent with cultivation was demonstrated in participation with people. This model suggested that areas on the sides of plots cultivated with landrace preferred by the farmer could be used for growing a few lines of the farmer germplasm for conservation and seed increase.



In this process, some farmers may opt to conserve same landraces. Regardless, the total number of available landraces in a region would be conserved across several farmers. Tribal community cooperation was good and voluntary since they realized economic benefit form landraces and saw the potential with the example of Kalajeera. People started planting more landraces and conserving them in VSBs. For example, the area allotted to landraces rose from 9 acres in 2001 to 78 acres in 2003. This would imply that unless a direct benefit to the livelihood of a farmer is demonstrated using their natural resources, conserving them will not be feasible. As an alternative, if monetary incentives were provided, then conservation activity would continue only until incentives are offered. One argument in favour was farmers are too poor to take conservation as an activity when several of the germplasm were not of direct interest. The counter argument is that incentives would discourage farmers from helping themselves. An analysis with several case studies concluded that direct incentives failed

to yield sustainable or replicable results (Giger, 1999). Further there would be no personal stake on that activity. But when people have themselves experimented and succeeded with realizing economic benefit from a few of them, the stake on conservation will logically intensify. With possibilities of providing protection to farmers landraces under Indian sui generis system (Protection of Plant Varieties and Farmers Rights Act 2001), a sense of possible ownership of landraces will itself work as an indirect incentive for their conservation. This was evident from the actual position of landrace conservation over the period 1999 to 2003.

In 1999 the model of Participatory Conservation was first demonstrated. In 2000, 99 families have conserved 98 landrace germplasm in 114 plots. In 2003, 64 LRs of the 98 grown in 2000 were multiplied in large plots. Scientists of MSSRF characterized them using 11 morphological traits.

Conservation of genetic resources by community is a priority area for MSSRF. Special emphasis is laid on conserving landraces in agrobiodiversity rich areas like Jeypore. A number of tribal communities there like Amanatya, Bhatra, Bhumia, Didayi, Dora, Gadaba, Gond, Gouda, Halva, Kandha, Kandhadar, Karana, Kolar, Koya, Kuita, Kuvi, Langia Soura, Paroja, Pentia, Rana, Sabarkandha, Soura and Sundhi were conserving valuable landraces as a tradition. While 1750 landraces of rice have been recorded to be present in Jeypore tract, an explorative survey conducted by MSSRF during 1995-96 could locate only 324 in the very area where more than thousand varieties were recorded 40 years ago.

In 1994, a munificent grant to support conservation activities was received from the Government of Italy through the efforts of Prof. Scarascia Mugnozza. This facilitated the establishment of a Community Gene Bank named G. T. Scarascia Mugnozza Community Genetic Resource Centre (SMCGRC). The SMCGRC maintains a herbarium of farmers' varieties, and also a farmers' database. The traditional knowledge associated with each accession, along with personal details and photograph of the person from whom the accession was sourced are kept in record at the SMCGRC. This would enable benefit sharing under farmers' rights envisioned in the Protection of Plant Varieties and Farmers' Rights Act (2001) enacted under Indian sui generis system. This Gene Bank is a medium-term storage facility maintained at 4° C and 25% RH. A duplicate sample of each accession is also stored in the long-term storage at the National Gene Bank as an additional safeguard. The accessions belonging to major food crops are notable for agronomic potential under different biotic and abiotic stresses. They are

Giger, M. 1999. Avoiding the Shortcut: Moving beyond the use of direct Incentives, Centre for Development and Environment, Berne, Switzerland

accessible by any party, subject to Indian laws, with prior informed consent of the holder community. MSSRF facilitates such access through mutually agreed terms and material transfer agreement.

Valuable landraces are available in natural habitats occupied by poor tribal farmers. The SMCGRC is a main source of guarding such farmers' germplasm. At times of distress and natural disasters in tribal regions native to those landraces, the community gene bank can provide starter material to retrieve and reestablish the lost germplasm. Village Seed Banks in remote areas of Jeypore Tracts are linked with the MSSRF Community Gene Bank. A duplicate set of germplasm seeds is kept in well-maintained medium term storage at Chennai. Seeds that are periodically regenerated using Participatory Conservation Model at various villages are sent to the Community Gene Bank for renewal, record and maintenance. Such documentation in the Community Gene Bank would help farmers when any landrace finds a remunerative market entailing statutory benefits like royalty.

The participatory initiatives that could ensure economic benefit to the poor tribal community of Jeypore combined with the Participatory Conservation mode by which people jointly conserve important landraces drew appreciation from the state and also from other concerned organization.

The efforts of MSSRF in creating partnership in conservation of biodiversity

and reduction of poverty involving tribal women and men at Jeypore, Orissa was one of 25 projects that were awarded the Equator Initiative Innovative Partnerships Award for Sustainable Development in Tropical Ecosystems at the World Summit on Sustainable Development held in Johannesburg in August 2002.

The Equator Initiative, a partnership of UNDP, UN's Global Development Network, IUCN, Government of Canada, and few other agencies, is a global movement committed to identifying and supporting innovative partnerships that reduce poverty through conservation and sustainable use of biodiversity. The programme is based on the recognition that, while biodiversity losses and poverty are increasing in most tropical countries, indigenous and other local communities are rising to meet these challenges in creatively effective ways.

Following the Equator Initiative Award, Panchabati Grama Unnayan Samiti (PGUS) was formed as a farmers' association in 2002 by villages working

with MSSRF. Panchabati is the old name of Koraput region, Grama Unnayan means rural development. Registered under the Societies Registration Act, the objective of PGUS is to popularize the success achieved with the help of MSSRF in harnessing science and technology to make the villages self reliant in agriculture and food sector. Representatives selected by central village communities of 17 villages constitute the executive body of PGUS. Half of them are women. They have been monitoring the conservation approaches in practice in 10 villages, are organizing training programmes in collaboration with MSSRF on integrated pest management and Modified practices of cultivation and have developed good linkages with the district administration. Due to their intervention, some extant but dormant government schemes have become functional in a few villages. PGUS is custodian of the Equator Initiative award amount. which is being maintained in a trust as a fund for community development. The interest from the amount would be used to process requests from villages for conservation and development work. Scope thus exists for systematic development work in all villages in rotation. The formation of PGUS may be seen as one of the first and finest examples of institutionalization of benefit sharing.

Participatory Breeding of Improved Varieties

During the process of knowledge addition, the farming community was given lessons on the differences between pure line varieties and hybrids. Most of the time, they were using the terms, Government varieties and hybrid varieties without really understanding the differences. In training classes, MSSRF scientists explained the process of emasculation-pollination in rice using plants raised in pots. This process generated immense curiosity and interest in both men and women. They volunteered to do emasculation and pollination along with scientists in a hybridization plot laid out at Patraput village. Farmers were explained the need for and process of staggered planting of varieties so that emasculation-pollination process can be completed over a period of time.

Based on the earlier performance of landraces, one upland, four medium land and two lowland varieties were selected as parents. Seven crosses were attempted, in two of which reciprocal crosses also were made.

Eight women and seven men from the three villages, Patraput, Tolla and Nuaguda volunteered to do emasculation, pollination. Some of them were old farmers with increased interest in agriculture, while some others were boys and girls who have various levels of schooling. From among the fifteen, four were chosen as volunteers who would take care of the crossed plants from external damage. Around 10,000 pollinations were made over a period of four weeks. But several pollinations did not succeed, leaving only 593 Fo seeds distributed over 5 crosses involving 5 parents.

Due to lack of expertise, the success of pollination was about 6% only. Those were sown as single plants in Patraput during Kharif 2000 in plots allocated to the individual crosses. However, due to heavy intermittent rain during crop growth, some plots were completely washed out and in others there was mixing of plants from adjacent plots due to rain, thus leaving only mixed F1s from the five crosses:

From each plot alloted to F1, 200 gm F2 seeds was selected at random from material harvested from each cross. Each of the 200 gm sample was planted equally in five lines during Kharif 2002. F3 populations from each of the five F2 lines were raised in 8m rows alternated with five rows of parents.

Two 3-plant composite samples from each row were used for observing the following quantitative traits: plant height, number of tillers, no. of panicles, panicle length, no. of filled grains per panicle and grain weight. Grain filling percentage was computed from the data. Analysis of variance (ANOVA) for each character was done on a multiple range test. Grouping was done using computed performance scores based on all the traits observed. Selections were made from among the 35 F3 lines on their statistical superiority over each of the 5 parents (as it was not known which F3 line was derived from which cross). Based on a multivariate mean test across all traits, F3s that exceeded 4 parents (Popln S1: F3 line 7), 3 parents (Popln S2: 2 F3 lines- 23, 31), and 1 parent (Popln S3: 2 F3 lines -6, 29) were selected. The F3 lines, as good as any parent, were grouped as Popln S4 (22 F3 lines). 8 F3 lines that did not exceed any parent significantly were discarded. The 4 selected F3 populations along with all the parents were advanced to F4 in Kharif 2004 in a design with parents in alternate plots for comparison. They were advanced to F5 in Kharif 2005.

Field observations showed synchrony of maturity in the populations S2, S3 and S4 compared to S1 that was still segregating; but S1 was early to flower compared to other populations. When compared with the possible five parents, all the 4 populations showed superiority. They would be homogenized in F6 and put in large field trials.

The community participating in the hybridization process reported here is novel; the tribal community with no Modified education was able to make crosses demystifying the notion that hybridization is a specialized job. In literature though we come across participatory evaluation of crosses in advanced generations by people at their habitats, we could not find instances similar to what we have reported here.

The experience of the community in participatory hybridization and breeding, coupled with participatory conservation would strengthen activities of conserving landraces. This is because farming community have realized the commercial and nutritional value of purified landraces and have been a partner in the process of breeding superior populations combining useful traits from parent landraces through hybridization. Thus, both participatory breeding and participatory conservation initiatives would stay, as activities within the reach of tribal community. The experience gained by the community should stay in good stead for continuing conservation as a regular activity.

Empowerment and Capacity Building of Women through participatory research

In the beginning, the role of women in agriculture, the care and concern with which they take special efforts to feed their family and store other items of food to tide over times of annual want, in addition to their daily chores were brought to focus. Participatory research provided them valuable opportunity to learn scientific cultivation enhancing yield and income. Their knowledge on seed selection got sharpened; they found opportunities to discuss problems of profitable agriculture and could gain scientific knowledge.

To assess how much they gained in knowledge and benefited in general, random enquiries were made of women from various participatory and non-participatory villages. The results are summarized in the following table.

It was clear that women have been empowered with optimal cultivation techniques and seed purification, selection and storage. The practice of seed exchange on loan-and-return with interest mode has been strengthened and put to advantage for expanding area under landraces. More women are participating in scientific cultivation in 2005 compared to 1998. In turn, on the model of participatory conservation, more landraces would likely be conserved. In a village, Tolla four women Self Help Groups with 20, 10, 13, and 15 members

Empowered knowledge and capacity of women

Activity	No. of villages	No. of Woman farmers	1998	2005
Line Transplanting	3	4	No knowledge	High Skill, high knowledge Capacity to extend to otherss
Modified Cultivation	4	5	Following ancient practices	Knowledge gained practices on Modified method Participatory cultivation
Group farming	3	6	No knowledge	Economic gain
Seed selection	5	9	Low priority extension to others	High priority Good knowledge Confident
Quality Seed Production	1	1	No knowledge	Good knowledge Confident of extending it
Seed exchange	1	1	Less opportunity	More opportunity
Seed storage system	1	1	Not available	Available
Kalajeera cultivation	1	4	Not available	Adopting Modified method

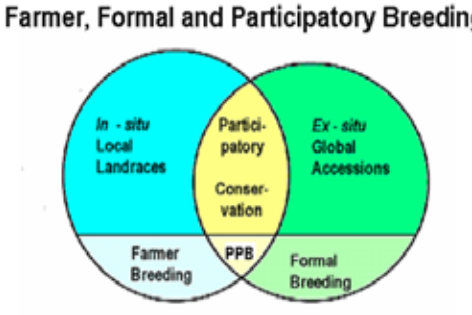
regularly organize training on pure seed collection, purification, and preservation, in addition to transplanting, weeding out non-type plants, FYM application etc. This would indicate the initiative built up with the activities and experience of participatory plant breeding. Their work pattern evolved for the better with saving on drudgery time that could be channeled productively. They highlighted the following important areas where there was significant improvement compared to 1998 when participatory research was initiated.

Processes	1998	2005
Scientific cultivation	Unknown	High awareness
Women participation	less	High with initiative to practise
General knowledge on Agriculture	Less	High
Confidence to talk on optimal cultivation	Nil	Very good
Working hours	More	Less
Economic gain	Nil	Good
Sowing	Broadcasting only	Nursery; transplanting
Yield	Low	High and Remunerative
Land preparation and management	Poor	Good

Women informed that they derived several benefits on many activities after involving themselves in participatory plant breeding for improvement of landraces. Some benefits recounted by them were: fewer weeds, drudgery reduction in sowing, less seed rate, savings on weeding, harvest etc., more working days available with more time for gainful employment, healthy crop with no lodging, easy harvest and remunerative market.

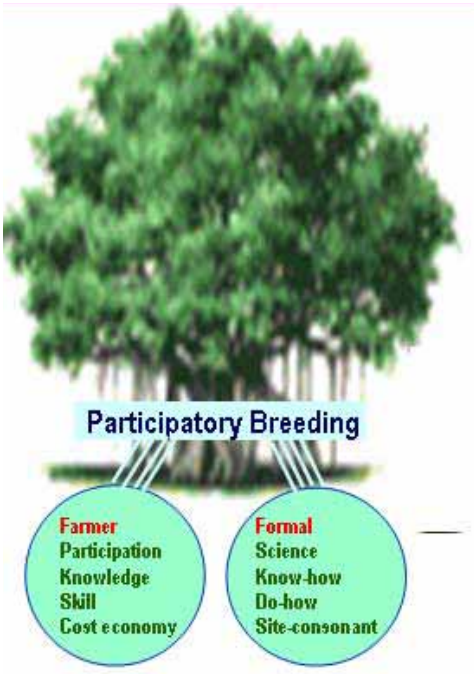
The story of Jeypore after participatory breeding and improvement of landraces has clearly shown the following:

1. Ex-situ germplasm is well conserved in global gene banks and this activity is well-funded. But poor farming communities conserve in-situ, site- and eco-specific germplasm at their own cost, as in the case of Jeypore, but this activity attracts little or no funding. Further, in-situ local landraces possess a number of special traits that remain to be utilized in either conventional or modern breeding.
2. Farmer breeding is based on the in-situ germplasm, mostly by selection, and in the case of empowerment of their knowledge, by specific methods of plant breeding also.
3. Modified and modern breeding use essentially ex-situ germplasm.
4. Participatory conservation is the intersection of in- and ex-situ germplasm in the sense that the methodology can be effectively used in either case.



5. Like wise the intersection of farmer and Modified breeding is Participatory Plant Breeding, as this model of breeding can utilize both ex- and in-situ germplasm. For example, one can derive useful derivatives initiating from crosses of the type, landraces X ex-situ accessions.

The experiences gained from participatory research with the tribal community of Jeypore tract of Orissa have highlighted that the tree of Participatory Breeding grows on the soil of mutual help and



participation; it stays strong amidst various stresses with a root system strengthened by Farming community (in terms of Participation, Traditional knowledge and skill, and need for affordable cost), and Modified concepts (guided by science, know-how and do-how that should be consonant with the site of action).

We attempt now to consolidate the experiences and convert lessons learnt into a set of guidelines for Participatory Plant Breeding, and in general, for Participatory Research. We believe that these guidelines would be applicable in a variety of cases of PPB, but would stop short of saying that these guidelines form a tool kit. This is because PPB is situation-specific; since situations widely vary, the action mode and action plans would vary. To the extent situations can be circumscribed by a common delineating boundary, these guidelines would have the potential to deliver positive dividends; they would also help to draw viable plans and pathway of action. We conclude by providing, within this ambit, the guidelines for efficient PPB.

- **The organization that desires to take up work in a site and its community should interact with men and women first and establish rapport before initiating PPB. Initially communities provide only cautious cooperation in view of their experience with various agencies approaching them on similar projects.**
- **It is important to listen to the views of the community on PPB and convince them of the contemplated PPB action plan. Their questions and doubts have to be patiently addressed and answered in a way that they can understand the logic. The best mode is PRAs (Participatory Rural Appraisal) in which both men and women of the community should be invited and provided space for equal participation.**
- **In view of the fact that women play a crucial role in agricultural operations like seed purification and selection, their opinion on the action path has significant weight. Tribal women, conservative in expression, particularly in presence of spouse, must be provided the necessary environment to voice their views.**
- **Recognition of gendered ITK is important. In addition to the skill of women in discarding wild mimicking plants, their knowledge in selection of varieties having good cooking quality (non-sticky), easy cooking, greater bulk after cooking, capacity to provide relatively longer energy and suitability for value added product like popped, puffed and pressed rice must be given due merit.**

- ‘Practice before precept’, ‘Learn first to lead later’, ‘Facilitate than prescribe’ are the key guiding principles on which action plans should be built.
- Poor tribal people with which we worked are uneducated and live their life solely on ancestral tradition. Steadfast in their belief on tradition and ancestral prescriptions, they do not respond readily to change. Therefore knowledge supplementation should be a regular exercise. Site scientists need to visit their habitats often and equip them with scientific information and knowledge.
- Monetary incentive in return for participation has been usual in PPB initiatives. This mindset has to be arrested right from the beginning. The principle of equal and voluntary participation for a cause, with scientists providing the know-how and farmers learning the do-how based on knowledge received, should be the implementation principle.
- Text book methods of breeding should not take precedence over simple, doable action plan that promises a high degree of success. For example, it is not prudent to start with pure line breeding and to engage people in testing products of crosses in segregating or advances generations. That would mystify science and people would only be field workers obeying delivered rules; they would never own the rules or like to replicate them in case of program withdrawal.
- Community in villages, particularly tribal community, likes to follow their elected Panchayat leaders. Any program initiated, like PPB, should therefore include the village administrative functionaries in every phase of action plan. The experiments could then be planned on a consensus, implemented and executed safely without any external harm. For instance, in the first year of our PPB, non-inclusion of the Panchayat Raj Institution left parts of the experimental rice crop grazed by cattle.
- It is crucial to plan the first action with utmost care and caution. People will not take it kindly if the first action fails to succeed, however strong the logic behind may be. Therefore it is essential to plan cost-effective steps of action that have a high chance of success and potential to show gain. In our PPB, we planned only changes in agronomic inputs retaining those that do not cause stress. For instance, lands in Jeypore were fairly fertile. Small and marginal

farmers do not apply organic manures regularly due to non-affordability. PPB action plan did not insist on manuring fields, and our PPB initiatives resulted in significant increase in yield and income.

- It is crucial to demonstrate the efficiency of PPB rather than stressing on its documented success. This would imply that the new plan of action must be compared with the method, the community was following in the field, and it is useful if people were made to practise old and new methods themselves under guidance from scientists. It would be more effective in driving home the sure advantage of the new method.

- New participatory methodology must ensure proper layout and efficient field design so that statistical data can be collected, analyzed, evaluated and valid scientific inferences drawn.

- More important is discussion of results with people, who have experimented new methods, in a way they could understand and participate in decision-making. In the case of Jeypore initiative, the ranking of landraces on a joint statistical evaluation of performance based on seven morphological traits matched peoples' judgment almost exactly. In one case where peoples' ranks of 1 and 2 were reverse on scientific evaluation, the decision was taken in favour of peoples' indigenous technical knowledge. These processes made people happy and gave them the satisfaction of deciding which landraces were to be tested in large scale. Such satisfactory participation ensures vigorous progress in subsequent years.

- It is not enough if PPB design succeeded in increasing productivity and production. Poor farmers are vulnerable for exploitation. They would not be able to market the produce on its deserving price. It is therefore essential to show them viable paths of marketing. In the case of Jeypore, in the first year of large production, farmers were shown how they could sell paddy to fellow farmers as hand-pound nutritious rice. In the next year, when production touched 30 tonnes, the pathway of getting them procured by a Government subsidiary, NAFED was shown. In all those efforts, we drove home the need for cooperative storage of produce and cooperative marketing. People were enabled to store the produce in VSBs and the huge disposable paddy in a rural godown for NAFED to easily

procure. Such steps ensured storing uniformly good paddy that fetched a high price for the first time in Jeypore tribal history. However, market sustainability is a live problem and would need dynamic solution.

Therefore PPB is a guiding light for community to produce and profit. The circle of scientific cultivation, improved production, efficient storage and profitable marketing must be completed and demonstrated.

People management of all those processes must be institutionalized. We believe the PPB initiatives we have experimented in Jeypore will, in due course, be replicated in other regions and Orissa State as a whole. The Government of Orissa needs to rise to the occasion and channel the peoples' initiative and enthusiasm towards Conservation, Cultivation, Consumption and Commercialisation towards accelerated poverty reduction.